PERIODONTAL DISEASE IN ASSOCIATION WITH SYSTEMIC DISEASES IN THE DOG

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ABSTRACT

Periodontal disease (PD) is the second most common disease affecting dogs in UK veterinary practices. Veterinary and human literature suggests that periodontal disease may be associated with bacteraemia and a chronic, systemic release of inflammatory mediators which produce direct or immune-mediated changes elsewhere in the body. Thirty canine periodontal patient's electronic medical histories were analysed for comorbidities. The findings were analysed overall to identify any possible associations. Seventy three percent of these dogs had comorbidities, most commonly haematopoietic, cardiovascular, musculoskeletal and hepatic systems were involved. The most prevalent comorbidities were: high liver enzymes, heart murmur, mitral valve disease, and monocytosis. Other interesting comorbidities were: endocarditis, neutrophilia, submandibular lymph node enlargement and arthritis. Periodontal disease patients had a higher prevalence of disease when compared to the disease prevalence data for UK pet dogs in general. Mitral valve disease was over 17 times more likely in the

periodontal disease patients. Comorbidity disease prevalence also increased with more severe periodontal disease stages. This study supports an association between periodontal disease and systemic diseases in the dog. Further studies should focus on confirming a cause and effect relationship. Until then, these data may be useful for veterinarians to examine periodontal patients for concurrent diseases and can be used as a tool to promote dental disease prevention to pet owners.

Key words: comorbidity; dog; periodontitis; periodontal disease; systemic disease

INTRODUCTION

Periodontal disease (PD) is the second most frequently seen disease in dogs in a veterinary practice in the United Kingdom [17]. Eighty percent of dogs show signs of periodontal disease by three years of age [29] and the incidence of the disease increases considerably with advancing age, causing significant oral pain and suffering [22]. Pet owners

are currently recommended to brush their dog's teeth once per day, although compliance to this oral hygiene recommendation is low [12, 15].

Periodontal disease may act as a source of bacteraemia and chronic inflammation causing a chronic systemic release of inflammatory mediators, bacterial and cellular by-products which may lead to direct or immune-mediated changes elsewhere in the body.

There is evidence in both the human and veterinary literature of an association between periodontal disease and systemic diseases. In humans, 57 systemic conditions are being researched in connection to periodontal disease; most of which are the result of chronic inflammatory disease [14], including cardiovascular diseases such as atherosclerosis, stroke and coronary heart disease [1, 16,], endocarditis [8], rheumatoid arthritis [2, 4, 5,], diabetes [6, 26] and pregnancy complications such as preeclampsia [3, 21], low birth weight [9] and premature delivery [28].

Less literature is available on dogs, although, mitral valve disease, atherosclerosis [19], histologic changes in the myocardium [7], endocarditis [11, 25], chronic kidney disease [10, 24], hepatic pathology [19], diabetes [13, 18, 20] and meningoencephalomyelitis [27] have been reported.

The aim of this study was to select canine periodontal patients, grade the severity of the periodontal disease, identify concurrent systemic diseases in each patient and analyse the overall findings to identify potential associations.

MATERIALS AND METHODS

Sample selection

Gatehouse Veterinary Centre in Lavister, a small animal first opinion veterinary practice in Wales, UK, provided access to their canine periodontal patient medical histories. The 30 most recent periodontal patient dental examination patients were selected, and their electronic medical histories analysed for concurrent diseases. The sample included 30 dogs of 18 breeds, aged 2 to 16 years of which 13 were females and 17 males.

Stage of periodontal disease

The patient's dental charts were analysed to determine the level of severity of periodontal disease. Guidelines for staging were outlined on the dental charts to allow the veterinary surgeons to categorise each stage in the same way.

Table 1. Periodontal patient medical histories

	Breed	Age in years	Gender	Neuter status	PD stage	Comorbidities
1	Cross	11	Male	Neutered	1	Dermatitis
2	Cavalier King Charles spaniel	9	Male	Neutered	1	Severe mitral valve disease, Chronic heart failure
3	Cavalier King Charles spaniel	9	Male	Neutered	1	Mitral valve disease, Heart murmur, Otitis externa, Cranial cruciate ligament rupture
4	Shetland sheep dog	5	Male	Neutered	1	Heart murmur
5	Miniature Schnauzer	8	Male	Intact	1	None
6	Border terrier	5	Male	Neutered	1	None
7	Yorkshire terrier	5	Male	Neutered	1	None
8	Terrier	2	Male	Intact	1	None
9	Border terrier	13	Male	Neutered	2	None
10	West Highland terrier	10	Female	Neutered	2	High total protein, High liver enzymes, Arthritis of the stifle, Carnassial abscess

Table 1. Continues

	Breed	Age in years	Gender	Neuter status	PD stage	Comorbidities
11	Cavalier King Charles spaniel	10	Male	Intact	2	Anal adenoma
12	Miniature Poodle	8	Female	Neutered	2	High bile acids, Diffuse hepatic changes, Liver disease, Hepatic vascular dysplasia, Splenic reactive lymphoid hyperplasia
13	Dachshund	8	Female	Neutered	2	Intervertebral disc disease, Anal gland impaction, Sebaceous cyst
14	Cross	8	Female	Intact	2	Erythrocytosis, Reticulocytosis
15	Bull terrier	8	Male	Neutered	2	Fibroadnexal hamartoma
16	Coton de tulear	7	Male	Neutered	2	Lameness
17	Jack Russel terrier	9	Female	Neutered	2	None
18	Labradoodle	4	Male	Neutered	2	None
19	Jack Russel terrier	13	Female	Neutered	3	None
20	Jack Russel terrier	16	Male	Neutered	3	High liver enzymes, High total protein, Osteoarthritis of the elbow
21	Cross	15	Female	Intact	3	High liver enzymes, Squamous cell carcinoma under tongue
22	Jack Russel terrier	14	Male	Neutered	3	Erythrocytosis
23	Lhasa apso	14	Female	Neutered	3	High urea, Thrombocytosis, Cystitis,
24	West Highland terrier	12	Male	Neutered	3	Monocytosis, Neutrophilia, Lameness, Thrombocytosis
25	Bichon-Frise	11	Female	Neutered	3	Heart murmur, High liver enzymes, Lymphopenia, Lameness, Thrombocytosis
26	Miniature poodle	11	Female	Neutered	3	Mitral valve disease, Endocarditis with valvular and septal lesions, Heart murmur, Monocytosis, Submandibular lymph node enlargement
27	Cocker Spaniel	10	Female	Intact	3	Arthritis of the elbow, Monocytosis
28	Yorkshire terrier	10	Female	Neutered	3	High liver enzymes, Erythrocytosis, Leukopenia
29	Jack Russel terrier	8	Female	Neutered	3	Reticulocytosis
30	Chihuahua	6	Male	Neutered	3	Heart murmur, Intervertebral disc disease

Table 2. The most common organ systems affected in PD patients and their corresponding comorbidities

Organ System	Comorbidity	Number of PD patients affected
Haematopoietic	Monocytosis	3
	Thrombocytosis	3
	Erythrocytosis	3
	Reticulocytosis	2
	Leukopenia	1
	Lymphopenia	1
	Neutrophilia	1
		Total: 14
Cardiovascular	Heart murmur	5
	Mitral valve disease	3
	Chronic heart failure	1
	Endocarditis	1
		Total: 10
Musculoskeletal	Lameness	3
	Arthritis	2
	Intervertebral disc disease	2
	Cruciate rupture	1
	Osteoarthritis	1
		Total: 9
Hepatic	High liver enzymes in blood	5
	Hepatic vascular dysplasia	1
	High bile acids in blood	1
	Liver disease	1
		Total: 8
Urinary	High total protein in the blood	2
	Cystitis	1
	Urea in the blood	1
		Total: 4
Tumour	Anal adenoma	1
	Fibroadnexal hamartoma	1
	Squamous cell carcinoma under tongue	1
		Total: 3
Glandular	Anal gland impaction	1
	Sebaceous cyst	1
		Total: 2
Lymphoid	Splenic reactive lymphoid hyperplasia	1
	Submandibular lymph node enlargement	1
		Total: 2
Dermatologic	Dermatitis	1
	Otitis externa	1
		Total: 2
Dental	Carnassial abscess	1
		Total: 1

Stage 1 was characterised by marginal gingivitis, involving a red line with some oedema, Stage 2 was characterised by swelling and some bleeding and stage 3 was characterised by severe inflammation and spontaneous bleeding [23].

Medical history analysis

Using the electronic medical histories, haematology and biochemistry test results, pathology laboratory reports, dental records and consultation and surgery notes were analysed to identify comorbidities. This was facilitated by the practice recommending pre-anaesthetic blood tests for patients before dental examinations.

RESULTS AND DISCUSSION

The periodontal disease patient sample involved a wide range of breeds, ages, genders and periodontal disease stages. From the sample, 73 % of the periodontal patients were found to have one or more comorbidities (Table 1).

There were common associations in the periodontal patient samples. Certain organ systems were affected more frequently than others. The haematopoietic and cardiovascular systems were the most prevalent systems affected (Table 2) and included heart murmur, mitral valve disease, chronic heart failure, endocarditis and monocytosis amongst other comorbidities.

Table 3. Top 10 most common comorbidities in periodontal patients

Top 10 most common Comorbidities	Number of patients affected
High liver enzymes	5
Murmur	5
Mitral valve disease	3
Monocytosis	3
Lameness	3
Thrombocytosis	3
Erythrocytosis	3
Arthritis	2
Intervertebral disc disease	2
Reticulocytosis	2

The most common comorbidities were: high liver enzymes, heart murmur, mitral valve disease, monocytosis and lameness (Table 3). Other interesting concurrent diseases included: neutrophilia, submandibular lymph node enlargement and arthritis. These findings potentially reflect chronic, systemic inflammation.

There was a significantly higher disease prevalence in periodontal disease patients in the study when compared to UK pet dog data [17] (Table 4). In periodontal patients, mitral valve disease was over 17 times more likely, heart disease generally was over 6 times more likely and heart murmur was over 4 times more likely. This suggests that periodontal disease could be an important factor in the development of systemic diseases. The comorbidity prevalence increased with more severe periodontal disease.

Fifty percent of patients with stage 1 periodontal disease had comorbidities, 70 % of patients with stage 2

Table 4. Disease prevalence [%] in the UK dog population compared to periodontal patients

Comorbidity	Disease prevalence data for UK pet dogs [17]	Disease prevalence in periodontal disease patients
Heart murmur	3.94	16.7
Heart disease	0.88	6.7
Mitral valve disease	0.57	10
Lameness	1.7	10
Arthritis	2.83	6.7
Hepatopathy	0.49	3.33

Fig. 1. Percentage of patients with comorbidities according to the periodontal disease severity

had comorbidities and 92 % of stage 3 had comorbidities (Fig. 1). This suggests that the more severe the periodontal disease becomes, the greater the chance of systemic disease developing.

DISCUSSION

The findings support an association between periodontal disease and systemic diseases in the dog. The data also support current literature which links canine periodontal disease to heart disease [7, 11, 19, 25] and hepatic pathology [19] and can be related to human associations such as: arthritis [2, 4, 5] and endocarditis [8].

This study suggests that periodontal disease could be an important factor in the development of systemic diseases. The identification of associations between periodontal disease and systemic diseases suggest that periodontal disease could be used as an early warning tool to detect concurrent diseases. Comorbidities could also be diagnosed and treated sooner resulting in improved welfare and longevity.

This study focused on an association as opposed to identifying a causal relationship. Future studies should work towards identifying a cause and effect relationship, for example by comparing microbiology samples from the periodontium and affected systemic organs. This would support the idea that treating and preventing periodontal disease may prevent and treat comorbidities such as endocarditis.

Until then, this data might be useful for veterinary surgeons to examine periodontal patients for concurrent diseases and can be used as a tool to promote dental hygiene recommendations to pet owners. It is currently recommended to brush a dog's teeth once per day using toothpaste especially made for dogs. Regular veterinary check-ups are important to identify early signs of periodontal disease and veterinary treatment may be required to prevent its development.

CONCLUSIONS

Concurrent systemic diseases were identified in 73 % of the periodontal patients sampled. The cardiovascular and haematopoietic systems were particularly affected. The most common comorbidities were high liver enzymes, heart murmur and mitral valve disease amongst others.

The comorbidity incidence increased with PD severity and there was significantly higher disease prevalences in the periodontal patient samples compared to the UK pet dog data. This study supports an association between periodontal disease and systemic diseases in the dog.

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